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ABSTRACT

This study examines the contributions of infant temperament and maternal style to the development of behavioral inhibition during the first year of life. It was hypothesized that children whose mothers allowed them to experience small amounts of frustration, thereby allowing the child to develop coping strategies for such situations, would show less inhibition than other children. Two extreme groups of infants were selected at 4 months based on their reactions to change and variation in auditory, visual, and olfactory stimuli: (1) infants who demonstrated high degrees of motor activity and crying, and fast heart rate; and (2) infants who showed low degrees of the same characteristics. Infants and their mothers were videotaped in their homes when infants were 5, 7, 9, 11, and 13 months old. Visits to the homes revealed individual differences among mothers in their responses to infants' crying and fretting, and in limit-setting behavior. Results indicated that mothers of highly reactive children who were indirect in their limit-setting late in the first year, and highly responsive to fretting and crying early in the first year, facilitated the actualization of an inhibited profile given the infant's initial temperamental bias. Both infant temperament and maternal style contributed to the display of fearless or fearful behavior in laboratory assessment when infants were 14 months old. (GLR)

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THE DEVELOPMENT OF BEHAVIORAL INHIBITION:

INFANT TEMPERAMENT AND MATERNAL STYLE.

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ABSTRACT

This study examines temperamental and experiential factors in the development of behavioral inhibition over the first year of life. Two extreme groups of infants were selected at 4 months based on their reactions to change and variation in auditory, visual, and olfactory stimuli: infants who demonstrated high motor activity, high cry, and high heart rate, and infants who showed low motor activity, low cry, and low heart rate. These infants and their mothers were then videotaped in their homes at 5, 7, 9, 11, and 13 months. Home visits revealed individual differences among mothers in response to crying and fretting, and in limit-setting behavior. Both infant temperament and maternal style contributed to the display of fearless or fearful behavior in a laboratory assessment at 14 months.

There are many perspectives on temperamental differences among children. One perspective is based on the observation that children differ with respect to the initial response tendency in novel or unfamiliar situations that evoke uncertainty. When a large number of children are observed, there is one group that is fearless and outgoing in unfamiliar situations. These children are quick to engage in interaction and to approach novelty. They have been called uninhibited. Another group remains cautious and timid when confronted with novelty. These children are hesitant to speak to or interact with new people, and have been called inhibited. Kagan and others have shown that the behavioral differences between these two groups are preserved from 21 months to 7 1/2 years (Garcia-Coll, Kagan, & Reznick, 1984; Reznick et al., 1986; Kagan, Reznick, & Snidman, 1987; Kagan, Reznick, & Snidman, 1988; Kagan, 1989).

In addition, these behavioral differences are accompanied by a variety of stable physiologic differences. Inhibited children have higher and more stable heart rates than uninhibited children, higher levels of salivary cortisol and urinary norepinephrine, and greater levels of muscular tension as evidenced in decreased pitch variability when speaking words under conditions of mild stress (Kagan et al., 1984; Coster, 1986; Reznick et al., 1986).

Taken together, behavioral and physiological data suggest that there are two distinct groups of children whose stable behavioral profiles might have a biologic basis, possibly in thresholds for limbic arousal. Physiolologists have demonstrated that the limbic system, especially the amygdala, centrally mediates fearful or avoidant responses (Mishkin & Aggleton, 1981; Adamec & Stark Adamec,1983, 1986; Hitchcock & Davis, 1986; Dunn & Everitt, 1988). In the interest of time the relevant data will not be discussed.

However, these data are consistent with the possibility that individual differences in thresholds for limbic or amygdalar arousal might result in individual differences in fearfulness or avoidance, that is, in the behavioral profiles that characterize inhibited and uninhibited children.

Kagan and Snidman (1991) used assumptions about the biological basis for inhibited and uninhibited profiles to uncover the infant antecedants of the mature behavioral style. They exposed 4 month infants to change in auditory and visual stimuli and found four different reactivity patterns characterized by a combination of high or low levels of motor activity and fretting or crying. Each infant was classified according to the reactivity pattern he or she demonstrated (high motor-high cry, high motor-low cry, low motor-low cry, or low motor-low cry), and then seen again at 14 months. The fourteen month battery consisted of 17 episodes designed to elicit individual differences in fearfulness and inhibition. Four month reactivity to sensory stimuli was predictive of the level of fearful, inhibited behavior at 14 months, especially for the high motor-high cry and low motor-low cry groups.

Children who had demonstrated a high motor-high cry pattern at 4 months were significantly more fearful at 14 months than were children who showed a low motor-low cry pattern. That is, high reactive 4 month olds were likely to stay close to their mothers, resist mildly intrusive events such as the presentation of liquids for taste, and avoid approaching novel objects and unfamiliar persons at 14 months. Low reactive 4 month olds, on the other hand, were likely to explore the new environment away from the proximity of their mothers, accept intrusive events without distress, and readily approach novel objects and unfamiliar persons at 14 months. The infant's early reactivity pattern thus appeared to represent a temperamental bias toward a later behavioral style. In fact, preliminary results show that 4 month reactivity also predicts behavior

at 21 months.

Nonetheless, predictability must not be confused with immutability. Although children in temperament groups preserve their behavioral style, at all assessments--from infancy through 7 1/2 years--there have been children who have shown change. Most often change is evident in inhibited children who becomes less fearful over time, and interviews with parents have suggested that socialization practices might be linked to changes observed in the laboratory. For example, parents have reported that gradually introducing new children and peer groups (e.g., Girl Scouts) seemed to coincide with decreased timidity.

Thus, two sets of observations led to the current study: (1) that differences between inhibited and uninhibited children, though preserved overall, are occasionally characterized by changes that may be linked to parental practice, and (2) that the antecedents of inhibited and uninhibited profiles can be identified by patterns of reactivity in the young infant's response to change in novel sensory stimuli.

Method

This study was designed to investigate the contributions of infant temperament and maternal style to the development of inhibited and uninhibited behavioral profiles. We hypothesized that children whose mothers allowed them to experience small amounts of frustration, thereby allowing the child to develop coping strategies for such situations, would show less inhibition. We further hypothesized that this effect would be evident in the high reactive group, i.e., the group predisposed to develop fearful, inhibited profiles. It is composed of three major phases: (1) assessment of reactivity at four months to identify one group of high reactive and one group of low reactive children, (2) observation of these two groups in their homes bimonthly from 5-13 months, and (3) assessment of inhibited and uninhibited behavior in the

laboratory at 14 months.

Four month assessment. We attempted to control for gross confounds of maternal behavioral style by limiting our sample to a relatively homogeneous group. We saw only healthy, full-term, firstborn, Caucasian children from intact middle-class families. All mothers had a college degree or equivalent. None worked full time, or had plans to return to full time employment over the course of the study. Mothers were screened for depression with the CES-D (Radloff, 1977). All pregnancies had been healthy and unremarkable. One hundred and one infants were tested to identify 12 high reactive and 12 low reactive infants. Groups were balanced for sex.

Infants were exposed to changes in auditory, visual, and olfactory stimuli while behavioral response and heart rate were recorded. We looked for consistent patterns of reactivity across three areas: motor activity (weighted sums of limb movements and arches), fretting and crying, and baseline heart rate. Descriptive statistics for these items are found in Table 1. Children were assigned to reactivity groups by judges ratings and by meeting criteria on a quantitative scoring system described in Table 2. Pooling across all criteria, the high and low reactivity groups were non-overlapping. Groups were significantly different on each parameter, as shown on Table 3.

Home observations. The second major phase of the study consisted of a series of home visits to observe the mother's behavioral style in unstructured interaction with her high or low reactive infant. Two hour observations were videotaped bimonthly between 5 and 13 months. What differences among mothers did we observe? Variation in observed maternal style was consistent with variation in maternal

attitudes and beliefs, and with variation in advice available to parents in the popular literature.

On the one hand, mothers are told to adapt to the infant, to keep the baby happy, and to promote the development of a sense of trust. Early in the first year, mothers are advised to show sensitivity to the infant's signals by responding quickly and consistently to the infant's frets and cries. Later, mothers should avoid interfering with the infant's explorations, imposing limits gently and without confrontation.

On the other hand, mothers are advised that the baby must learn. It is the baby, rather than the mother that must learn to adapt to the demands of the environment. Mothers are to refrain from responding to every fret and cry so that the child might learn not to depend on mother to alleviate distress. Later in the first year, firm and direct limit-setting should be used by the mother in matters of safety and discipline so that the child will learn the parameters of safe or acceptable behavior.

In our coding of the home visit videotapes, we created variables to reflect the behaviors characteristic of these two perspectives (see Figure 1). Taken from continuously coded videotapes, including only general contexts (i.e., excluding caretaking, feeding, bathing) there were two maternal variables: responsivity and limit setting.

The responsivity index was taken from the 5-7 month home visits, and was the comparison of two conditional probabilities:

$$\frac{\text{The proportion of time mother held the infant while the infant was fretting or crying}}{\text{The proportion of time mother held the infant while the infant was NOT fretting or crying.}}$$

Responsivity scores ranged from mother much more likely to hold during fretting and crying to mother much less likely to hold during fretting or crying episodes. Note also that this index does not reflect individual

differences in the absolute amount of holding but in the distribution of mother's holding relative to the infant's distress signals (the correlation between holding and responsivity was negative and non-significant).

The second maternal index, limit setting, was taken from the 9-13 month tapes after the onset of independent mobility. We identified situations in which the infant engaged in behaviors that were dangerous to him or herself, dangerous to others, and messy or unhealthy. Examples included reaching for a sharp object, climbing onto an unstable surface, mouthing objects likely to cause choking, pulling on plants, striking mother, eating the cat's food, and chewing on dad's sneaker. The limit setting index was the proportion of time during these situations that mother issued a firm, direct command or prohibition, or removed an item directly out of the child's hand or grasp. High limit setting was characterized by firm, direct strategies. Low limit setting was characterized by indirect strategies (e.g., encouraging the child to surrender an object rather than removing it) or non-intervention.

Maternal responsivity and limit setting were uncorrelated in the entire sample, but somewhat correlated within reactivity groups. Mothers of high reactive infants were less likely to impose direct limits than mothers of low reactive infants ($F(1,20) = 3.65$, $p < .10$); there was no relation to sex of the child.

Fourteen month assessment. The third and final phase of the study consisted of a laboratory assessment of fearfulness and inhibition in response to unfamiliar persons, events, and objects for a total of 17 episodes at 14 months. The child's response to each of these episodes was coded to obtain behavioral indices of inhibited and uninhibited behavior.

The inhibition index was comprised of three behaviors: (1) fear, defined as fretting or crying during any episode or failure to approach during three stranger episodes (unfamiliar female with toys, robot, unfamiliar

female in costume), (2) time in proximity to mother during procedures occuring in a large playroom, and (3) resistance to mildly intrusive procedures such as the application of electrodes.

The index of uninhibited behavior was comprised of three behaviors characterized by positive affect. Components were: (1) smiles as a percent of trials during which the child smiles, (2) vocalizations as a percent of trials during which the child vocalized in a neutral or positive tone, (3) approach behaviors primarily reaching, in response to novel stimuli.

Results

What was the contribution of infant temperament to inhibited and uninhibited behavior at 14 months? As shown in Figure 2, high reactive infants were more fearful and less uninhibited at 14 months than low reactive infants. Notice that a comparison of extreme quadrants is highly significant when the variables are divided at the median. Six of the seven children who were both fearful and affectively subdued (high inhibited, low uninhibited behavior) had been high reactive at 4 months. On the other hand, all seven of the children who were both fearless and affectively spontaneous (low inhibited, high uninhibited behavior) were in the low reactive 4 month group (Fisher exact $p = .002$).

To assess the contribution of maternal behavioral style to the child's performance at 14 months a multiple regression model was used, and each reactivity group was analyzed separately. With reduced sample size, high leverage observations became problematic, and so non-parametric regressions were computed on the ranks of maternal responsivity and limit setting.

For the low reactive group, we found no significant relation between maternal responsivity or limit setting and either inhibited or uninhibited behavior at 14 months.

For the high reactive group, we found significant effects of maternal style on inhibited behavior. Multiple regression revealed ranked maternal behaviors to contribute approximately .50 to the variance in inhibited behavior for the high reactive group. Maternal limit setting accounted for the majority of the variance (.36), low limit setting associated with high levels of inhibition (see Figure 3).

The contribution of maternal responsivity to inhibition was not significant; still it contributed an additional .15 to the variance. High responsivity was associated with high inhibition (see Figure 4). It is informative to look at the partial plot of rank responsivity vs. the residuals of inhibition regressed on limit setting computed separately for each group (see Figure 5). The partial contribution of responsivity is not significant for either group, but a trend is suggested for the high reactive group (R^2=.24, F(1,10)=3.08, p=.11). In fact, the plot reveals a clear linear trend for the high reactive group with one notably deviant data point. The R^2 becomes about .60 with that data point removed; however more cases are needed to determine whether that position in the distribution remains atypical or not.

Maternal effects on uninhibited behavior for the high reactive group did not reach significance, but correlation patterns were in the opposite direction of findings for inhibition: r(10) = -.36 for responsivity, and r(10) = .18 for limit setting.

Summary.

These results replicate the finding that the 4 month reactivity profile is linked to inhibition at 14 months. In addition, in this study we have developed an index of uninhibited behavior and demonstrated a strong relation between 4 month reactivity and the child's level of both inhibited and uninhibited behavior.

Secondly, and more importantly, we have provided the first demonstration of an association between (1) maternal behavior within observationally defined temperament groups and (2) the infant profile of

inhibited and uninhibited behavior at one year. We interpret that association as evidence that mothers of high reactive children who were indirect in their limit setting late in the first year and highly responsive to fretting and crying early in the first year appear to have facilitated the actualization of an inhibited profile given the infant's initial temperamental bias.

We are currently adding more subjects to this sample of firstborn children, and continuing to follow them through 21 months. In addition, we are following a sample of secondborn children to assess additional family constellation contributions to the development of inhibited and uninhibited behavior patterns in high and low reactive infants.

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Table 1. Descriptive statistics: 4 month motor activity, fret, cry, and heart rate.

	Mean	S.D.	Median
Motor Activity	74.21	42.62	67
Cry (seconds)	11.94	19.18	0
Fret (trials)	6.79	5.90	5
Heart Rate (IBI's)	418.42	31.21	415.5

Note. N = 87 for motor, cry, and fret; N = 100 for heart rate.

Table 2. Proportion of sample scoring above and below selection criterion scores for motor activity, fret/cry, and heart rate at 4 months.

	Low Scores		High Scores	
Variable	Criterion	% Cases	Criterion	% Cases
Motor Activity	< 65	48.28	≥ 65	51.72
Cry (seconds)	0	54.02	≥ 4	45.98
Fret (trials)	≤ 10%	44.82	≥ 15%	44.82
Heart Rate (IBI's)	≥ 420	47.00	< 420	53.00

Note. N = 87 for motor, cry, and fret; N = 100 for heart rate.

Table 3. Means and standard deviations for motor activity, fret/cry, and heart rate for high reactive (n=12) and low reactive group (n=12).

Variable	High Reactivity	Low reactivity	t
Motor Activity	119.08 (41.67)	38.17 (24.38)	5.74****
Cry (seconds)	27.50 (24.86)	0 (0)	3.83***
Fret (trials)	12.08 (6.69)	0.67 (0.99)	5.88****
Heart Rate (IBI's)	395 (16.08)	450.58 (19.02)	- 7.73****

Note. Standard deviations are provided in parentheses.

*** $p \leq .001$
**** $p \leq .0001$

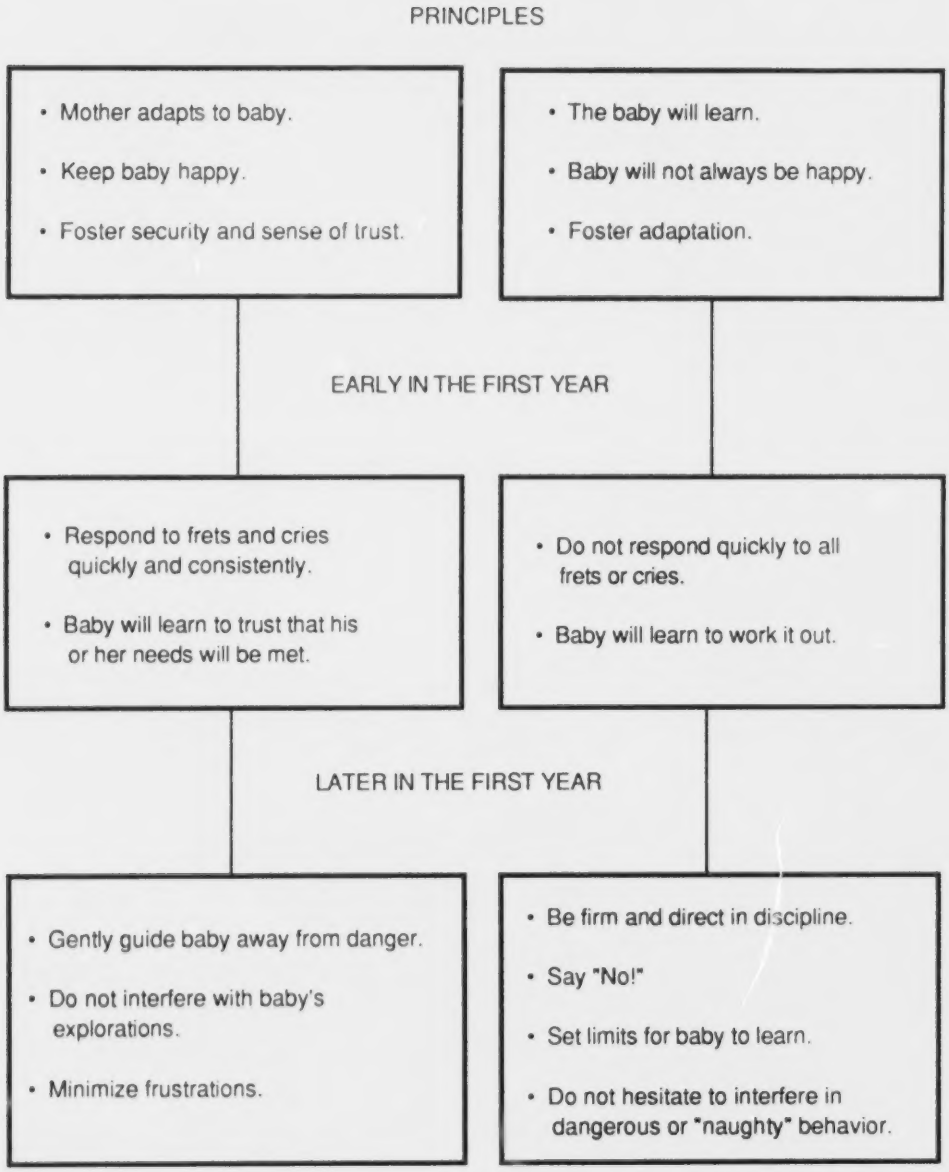
PRINCIPLES
• Mother adapts to baby.
• Keep baby happy.
• Foster security and sense of trust.
• The baby will learn.
• Baby will not always be happy.
• Foster adaptation.
EARLY IN THE FIRST YEAR
• Respond to frets and cries quickly and consistently.
• Baby will learn to trust that his or her needs will be met.
• Do not respond quickly to all frets or cries.
• Baby will learn to work it out.
LATER IN THE FIRST YEAR
• Gently guide baby away from danger.
• Do not interfere with baby's explorations.
• Minimize frustrations.
• Be firm and direct in discipline.
• Say "No!"
• Set limits for baby to learn.
• Do not hesitate to interfere in dangerous or "naughty" behavior.

FIGURE 1. Schematic summary of contemporary infant rearing perspectives.

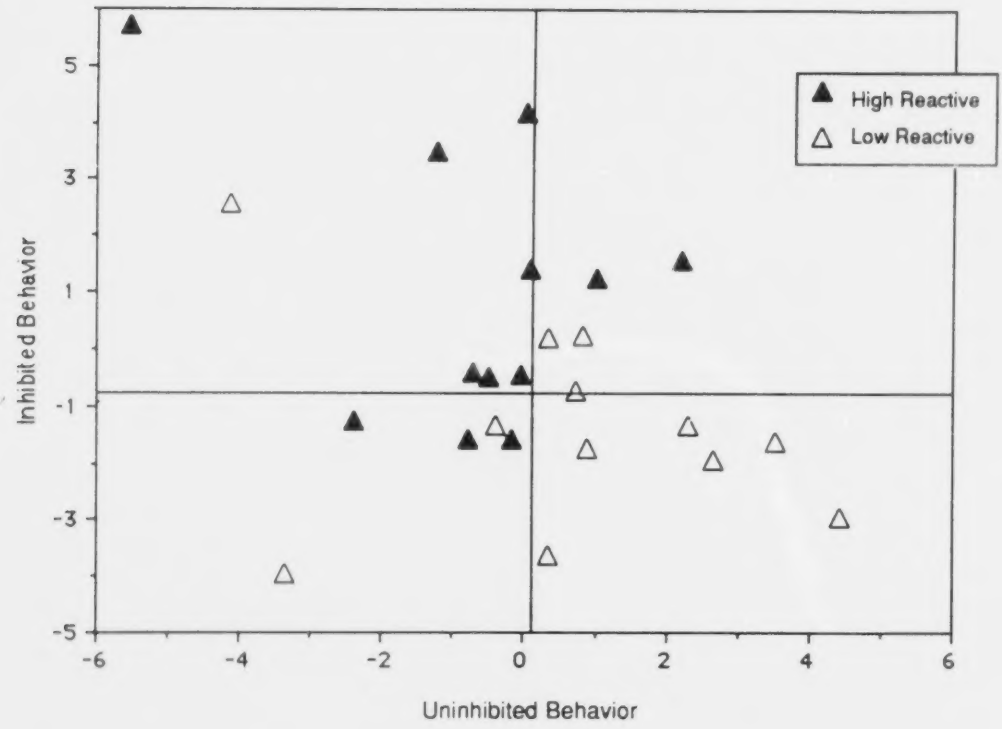

FIGURE 2. Inhibited and Uninhibited Behavior at 14 mos. by 4 mo. Reactivity Group.

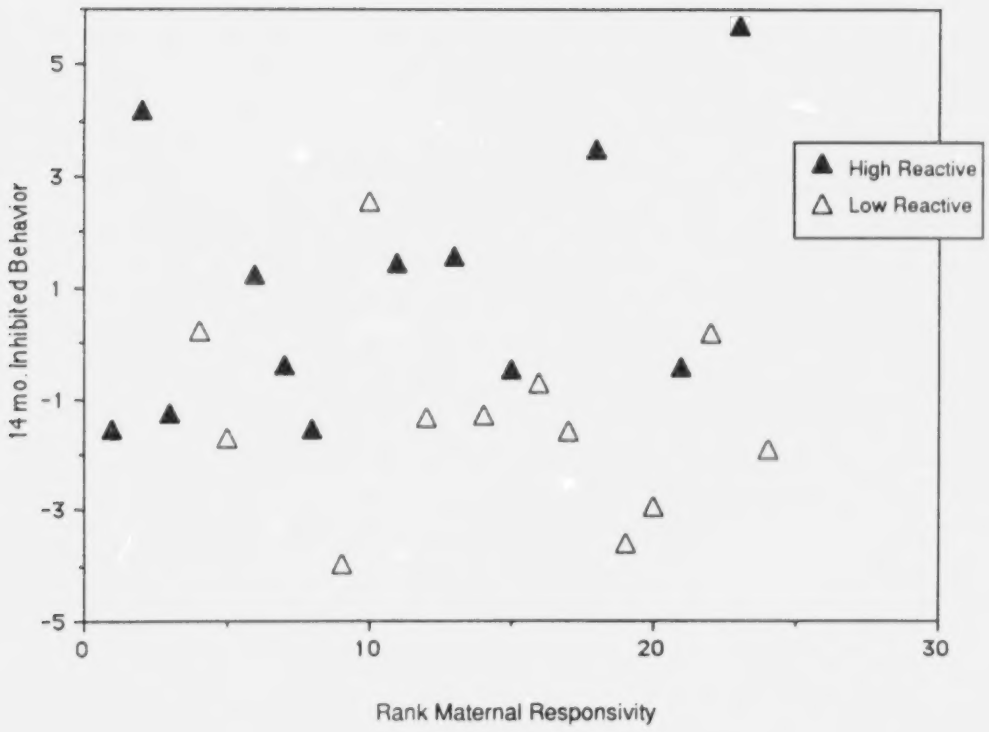

FIGURE 3. Relation of Rank Maternal Responsivity to Child's 14 mo. Inhibited Behavior.

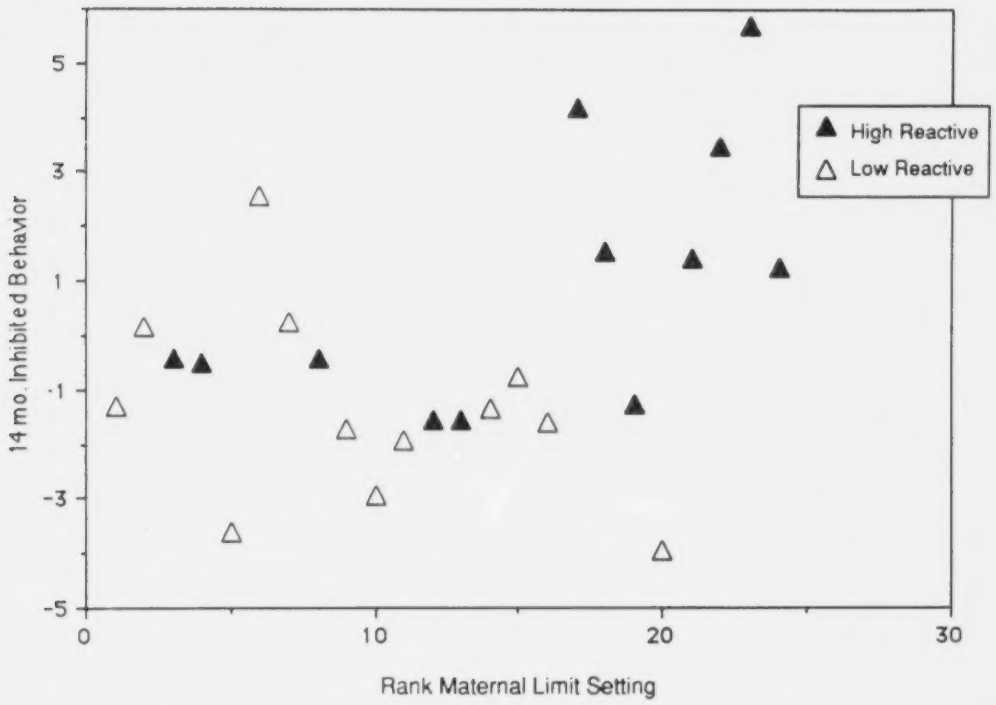

FIGURE 4. Relation of Rank Maternal Limit Setting to Child 14 mo. Inhibited Behavior.

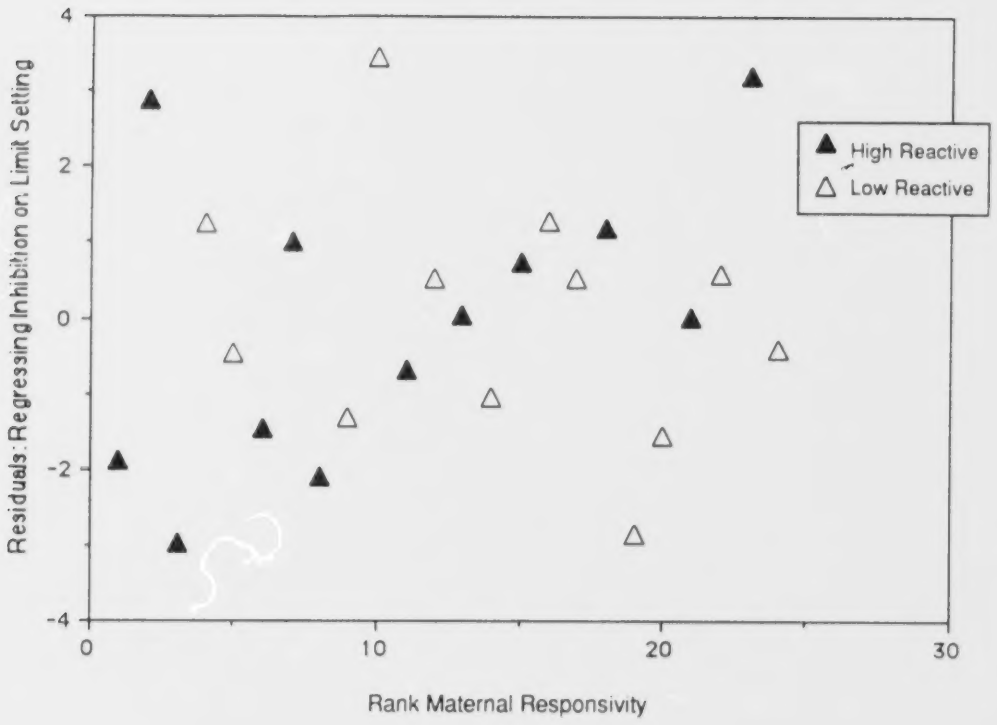

FIGURE 5. Relation of Rank Maternal Responsivity to the Residuals from the Regressions of 14 mo. Inhibited Behavior on Maternal Limit Setting Computed Separately for High and Low Reactive Groups.